THE
NAVIGATOR
HEAT EXCHANGER
COMSEC
FRITZ HULL

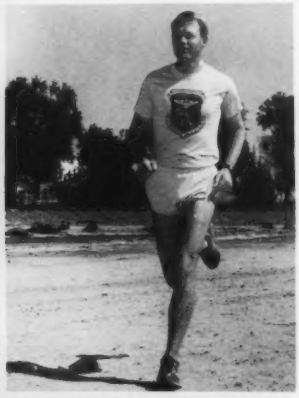
NAV OF NOTE

LIEUTENANT COLONEL BRUCE R. JOHNSON

Lieutenant Colonel Bruce R. Johnson commands the 93d Air Refueling Squadron at Castle AFB, California—the largest tanker squadron in SAC and the only one manned entirely by instructors. The 93d conducts initial flight training for all KC-135 pilots, navigators and boom operators.

Col Johnson is accustomed to cutting new trails. Before selection as commander, he was the squadron's first navigator operations officer. "Commanding a flying squadron is the dream of every rated officer. I saw the possibility of fulfilling that dream with the change in Title 10."

The colonel was ideally suited to be the squadron commander because of his extensive and varied background. A graduate of Hanover College, with a BA in Psychology, he entered the Air Force via OTS in September 1964. His first assignment, to navigator training school at James Connally AFB, Texas, was almost his last assignment. "The three months of study in electronics nearly terminated my budding career." With the same determination that has aided him throughout his career, however, he survived electronics training and excelled in the rest of the program.



Photos by A1C Rosemary Trumphour

Operationally, Col Johnson first served as a KC-135 navigator at Dow AFB, Maine. That northeastern tour was quite a change for someone raised in Illinois, but he enjoyed it. "I wish I had known enough to take advantage of the opportunities in the area." With Dow's closing in 1968, Col Johnson was assigned to the 2d Bomb Wing, Barksdale AFB, Louisiana, as a KC-135 instructor and flight examiner. January of 1972 brought his selection for duty as an EC-47 instructor navigator with the 360th Tactical Electronics Warfare Squadron, Tan Son Nhut AB, Vietnam.

After a year in Vietnam, Col Johnson moved to the 323d Flying Training Wing at Mather AFB. He progressed from instructor to UNT flight examiner and, finally, to Chief, UNT Flight Examiner Branch. "I believe the satisfaction of Mather duty is one of the best kept secrets in the Air Force. I really enjoyed it. It gave me the opportunity to affect the careers of many young navigators. Hopefully, I was able to lead by example and enhance the navigator's image."

Next came a career broadening assignment to Minot AFB, North Dakota. Col Johnson served as AMS maintenance supervisor, OMS maintenance supervisor, and as the OMS squadron commander. Again, he enjoyed the northern tour. "People who dislike northern bases usually have never experienced them. Minot is one of the most closely-knit communities anywhere. The maintenance experience was very beneficial in broadening my capabilities, as well as my career. It was the first time I worked with a group comprised mostly of enlisted personnel. I gained a great deal of respect for the work they do and the hardships they endure. I take every opportunity to pass this along to other 'sheltered' crew members."

Following his rated supplement tour, Col Johnson was assigned to Castle AFB. He quickly requalified as a KC-135 instructor navigator, taught several combat crew training school (CCTS) classes, and was selected to be a 93d AREFS flight commander. As such, he commanded a flight nearly the size of a SAC tactical squadron. Again, his leadership, background, and abilities earned him an assignment as Chief, Tanker Mission Development. The job involved planning, coordinating, and scheduling all CCTS KC-135 training sorties and managing 13% of SAC's total KC-135 flying hours. His leadership insured the graduation of 16 qualified crews every 18 days.

(continued on page 30)

FROM THE EDITOR

I am very pleased with this issue of THE NAVIGATOR—it truly offers something for everyone. For SAC navigators and electronic warfare officers, our features on Offutt's 38th and 343d Strategic Reconnaissance Squadrons provide a look at crew duty in the RC-135. If you're seeking a quick and easy way to complete celestial computations, we've got the answer. "Put the Stars in Your Pocket," explains how to compute star fixes with the TRS-80 pocket computer. Is it just interesting information you're after? We offer a perspective on a new Project Warrior group-study program. You history buffs can reminisce while recalling the B-58 Hustler or you can investigate the origins of our modern geographical coordinate system by reading "From Ur to Inertial-Our Geographical Reference System."

For anyone who has ever been or may be associated with C-130s, we have an introductory look at Little Rock's new C-130 flight simulator—the WST. Those who know it describe it as a marvel to behold. If you're anxious to brush up on operational skills, you'll benefit from reading "Backing Up the Approach." The article deals with one area where every navigator can be a real life saver. If it's culture and creative writing you enjoy, you'll relish "Over the Top," a stirring account of a trans-polar night flight. And, for those who anxiously await the outcome of the "fix" that Claude Naud found himself in, we provide the solution to "An Arctic Dilemma."

Once again, I encourage you to contribute your ideas, techniques, and experiences to YOUR magazine. Our content is as fresh and interesting as you, the contributors, make it. Your golden opportunity to become a "published" writer is at hand. We would like to help you reach that goal.

TO THE EDITOR

Dear Editor

THE NAVIGATOR is so replete with fascinating and informative articles that it pains me to offer a correction.

In "A Freak of Navigation" (p 15, No 3, Winter 1982) an error—which every navigator should have immediately noted—was made when 1 January 1900 was identified as a different century from the one containing 30 December 1899.

The year that ends in two zeros is not the first year of a new century; it is the century-ending year. *Webster's New Twentieth Century Dictionary* defines century as "a period of a hundred years reckoned from the beginning of the Christian era; as the first century 1 - 100; the nineteenth century 1801 - 1900, both inclusive." *Funk & Wagnall's Standard Comprehensive International Dictionary* adds, "...the twentieth century 1901 - 2000."

Arthur Clarke, author of *2001*—later made into the movie, "2001 - A Space Odyssey"—deliberately selected the first year of the next century for his intriguing futuristic saga.

"A Freak of Navigation" still stands out as prodigious, despite the fact that the Warrimoo did not exist in two centuries at the same time.

ARTHUR J. FRANKEL, Lt Col , USAF, Retired

Thank you for the kind letter informing us of the error in John Euller's account of the ship Warrimoo's navigational coup. After reading your argument and considering the evidence, I agree with you.

Everyone involved in the editorial process overlooked the mistake, including Charles McCabe who recalled the event in his San Francisco Chronicle column. I guess we're all guilty of the same misconception about when centuries begin and end. Your letter impresses me because I foresee your being the only one to catch the error. We appreciate your time and effort in researching the facts on century classification. It is always gratifying to receive reader feedback, but it is extremely nice when the reader is as concerned and constructive as you. Thanks again for your support.
THE EDITOR

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Department of the Air Force

THE NAVIGATOR

Proudly Serving Air Force Navigators Around the World Since 1953

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Whether you're a TAC WSO, SAC EWO, or a MAC CAM specialist, you'll probably agree that the popular navigator image is that of the traditional table nav—that dedicated, sometimes lonesome soul, busily laboring over a JNC, with dividers and plotters in hand. Our cover depicts not one, but two such souls—the dual, strategic reconnaissance navigators of the RC-135. Read their story, and get the scoop on Offutt's 55th Strategic Reconnaissance Wing, starting on pg 5.

If you've ever wondered about the origins of our geographical reference system, you'll enjoy "From Ur to Inertial" on pg 16.

AFRP 50-3

Distribution: One copy per two navigators.

THE RC-135 -THE AIR FORCE AS ADVERTISED

Captain Michael J. FALVEY
38 SRS
Offutt AFB, NE

HELP WANTED: Air Force Navigators—put your training and experience to good use! Good hours, excellent pay, and lots of travel. Outstanding opportunity for motivated individuals. Call or write your resource manager today.

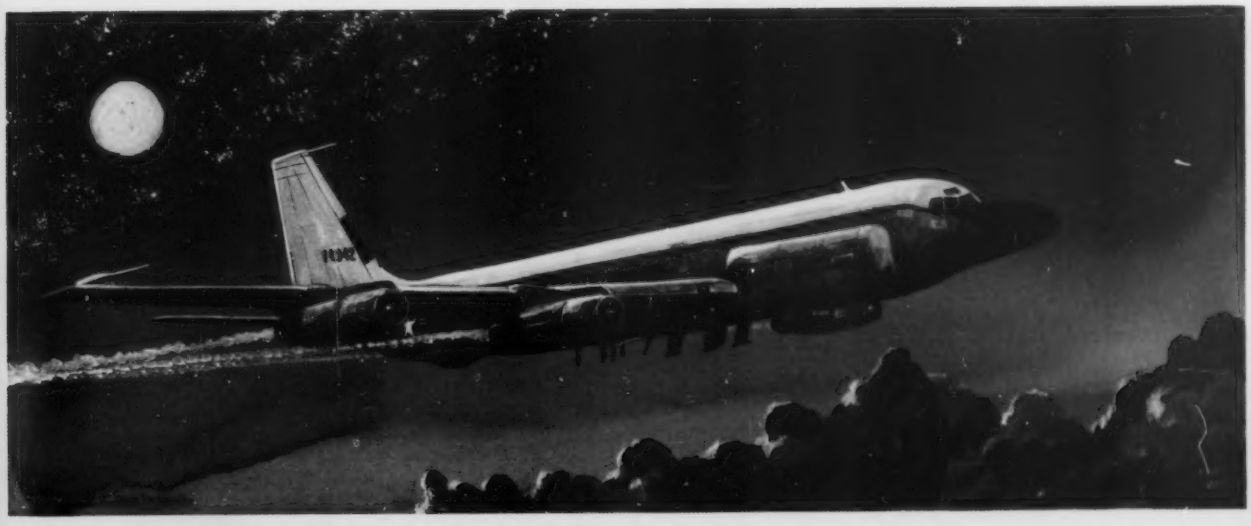
Have you ever wandered the halls of the alert facility or perused the squadron bulletin board and wondered what you would do if you saw such an advertisement? Even if you haven't, I'm sure you'll be interested in what I'm going to tell you. I wasn't a marketing major in school and I won't receive a bonus for recruiting anyone. I'll simply tell you about crew duty for navigators in the RC-135. The job will sell itself.

RC-135 "RECON" crew duty is unlike anything you've experienced—truly the Air Force as advertised. Stick with me a little longer and I'll shed some light on that claim.

Can you remember way back before you joined the Air Force? Whether it was six months or six years ago, almost all of our hopes and dreams were the same. We were exposed to the same recruiting materials. We viewed the same advertisements. We all wanted to fly and see the world. After completing navigation school, we felt that we could navigate anywhere in the world. We were eager to prove ourselves. So, how many of us soon found that, with higher fuel costs and efforts to conserve, we logged 300 hours of flying time per year instead of 1,000? How many of us found TDYs too few and far between, or found our travel experiences confined to one base operations after another? Finally, how many of us had to satisfy our desires to navigate around the world while seated in front of a celestial trainer or while replotting missions in the alert facility? If you've shared these experiences or if you're merely interested in changing aircraft, the RC-135 may be just what you're looking for.

I ask these questions because I had similar experiences only a few years ago. I knew that there must be something out there for me and I was lucky enough to find it. Believe me, the recruiters had the RC-135 in mind when they made their sales pitches. What makes the RC-135 such a good deal? The biggest benefit is the mission itself. I've read about several organizations claiming to have "the only peacetime operational mission." Suffice it to say that the 38th Strategic Reconnaissance Squadron truly can make that claim. Our operational missions provide great satisfaction because we literally put our navigator credentials on the line whenever we take the seat. Training is training, but too many times down the same air refueling track or around the same flagpole gets repetitive. Once checked-out and certified, "RECON" navigators don't find much time for continuation training—every flight counts.

If flying is what you like, then it's flying you get. We easily fly 800 hours per year and some RC navigators surpass 1,000. Many young squadron navs have accumulated 2,000 hours prior to pinning on their captain's bars. Granted, we aren't paid by the hour, but we are paid to navigate. The best way to perfect those skills is

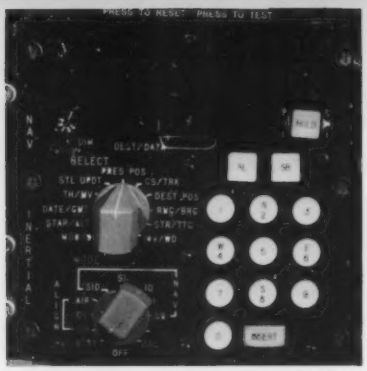


through real flight performance. We don't win any beauty contests by having 4,000 hours, but we do open some eyes, not to mention some doors, when we shop for new jobs. Yes, as good a deal as the RC-135 is, a time comes when everyone moves on. For the RC navigator, moving on usually includes moving up. A sample of recent 38 SRS navigator PCS moves includes two to the 1st Combat Evaluation Group, one to Test Pilot School, two to the E-4, and two to pilot training.

You won't have to worry about loneliness while flying yourself into a lather, because the RC-135 carries two navigators. The two navs sit side by side and use their own hot mike to exchange information without disturbing other crew members. Two navigators are needed because operational sorties require two independent positioning systems. The navigators are designated Nav 1 and Nav 2.

Nav 1, Capt Mike Falvey, checks the radar while Nav 2, Lt Rick Moses, uses the AFSATCOM system.

Nav 1 sits in the left seat and is responsible for the operation of the LN20 Stellar Inertial Doppler Navigation System. The LN20 is one of the finest navigation systems in the Air Force today. It uses its own stellar-inertial reference unit (SIRU) to shoot the stars, day and night, and update the aricraft's present position. The LN20 can find stars in the brightest sunlight and can fix in any of five positioning modes. In the stellar-inertial-Doppler (SID) mode, the system combines celestial, inertial, and APN 218 Doppler information for position updates. The stellar-inertial (SI) mode excludes Doppler data, while the inertial-Doppler (ID) mode excludes celestial position data. There is also a pure inertial mode, as well as a DR mode which converts the system into the world's most expensive ASN 7. When the LN20 is "cooking," as we say, it is truly a thing of beauty. The Nav 1 uses radar to confirm LN20 accuracy. As long as



LN 20 stellar-inertial-Doppler CDU.

it is working properly, the LN20 is coupled with the autopilot to direct the flight controls. The LN20 stores information on 39 separate destinations. Like the Carousel INS, the LN20 will direct the aircraft to stored destination waypoints in numerical sequence.

The second navigator, Nav 2, maintains an accurate DR position using the N1 compass and the APN 218 Doppler. Depending upon the type of mission, Nav 2 may update his DR with radar, celestial, and/or pressure. Operational procedures require a complete cross-check of information between Nav 1 and Nav 2 every 20 minutes. The cross-check includes position, heading, track, and ETA data. Neither navigator job is difficult, provided all equipment is working properly. If the LN20 fails, then Nav 2's information is considered most accurate. With that information and radar positioning, Nav 1 concentrates on air realignment of the LN20.

Another unique aspect of navigating the RC-135 is our use of the station stamp instead of an inflight log. After a mission, each navigator's chart is turned in for replot using stamped information. Through the use of station stamps, log information and chart work become inseparable.

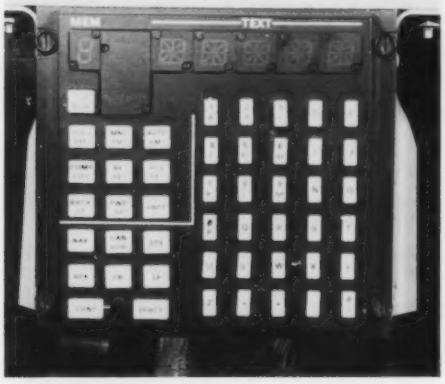
TIME
TK
D
HDG
CA/V
IH/MH
TAS
GS
D
T
ETA
ALT

TIME:

IH	CEL
CONV VAR	J-4
GH MH	N-1

STATION STAMPS

Besides navigation duties, Nav 2 operates the onboard Air Force Satellite Communication System (AFSATCOM). With a power panel, control panel, keyboard, and printer, the AFSATCOM provides rapid communications with ground terminals. The AFSATCOM communicates everything from operational reports to weather updates.



AFSATCOM control box.

Newly assigned RC-135 navigators normally spend some time as Nav 2. Those fresh from Mather must accumulate 1,000 total flying hours before upgrade to the Nav 1 position. Navigators cross training from other aircraft need 250 hours of RC time, in addition to the 1,000 hours in other systems, before upgrade. With the hours requirement met, upgrade is simply a matter of proving one's ability. At the rate we fly, the hours requirement is the least of anyone's concerns.

Now about that TDY I mentioned earlier. RC-135 navigators average 120 days of TDY per year. Flying from our forward operating locations, reconnaissance TDY trips are anything but few and far between. Many navigators volunteer for additional trips, bringing annual TDY to over 200 days. An average trip is 23 days. Individual sorties can exceed 14 hours. While TDY, free time is well deserved and you'll seldom have enough of it to become bored. The time between trips varies from two to eight weeks depending mainly on the luck of the draw. All quarterly flying requirements are easily met while TDY. When you return home, you are tired but satisfied in having proven your mettle as a navigator and having contributed to an important mission. While home, you can complete ground training requirements and work on any additional duties. You won't hear many complaints about the time that most crew members serve at home between trips. The most

common complaint is that time between TDYs is too long.

Well, with plenty of flying time, lots of good TDY, and the knowledge that you are one of the best navigators in the Air Force, what more could anyone possibly want? A clue to the answer lies in the word "future." Staff opportunities for navigators with a reconnaissance background are plentiful. Job opportunities range from overseas locations to the Pentagon.

Since you're now convinced that the RC-135 is the greatest thing since sliced bread, I'll conclude with a little straight talk. If it's such a good deal, why advertise at all? The answer is as obvious as your last back-to-back on alert. Good navigators are always in demand. Add to that the value of a reconnaissance background, and our squadron Alpha roster becomes a revolving door. Primarily though, I just want to spread the word about a great job. You must agree that "RECON" duty certainly sounds interesting.

I'm not from Missouri, but I've always had a "show me" attitude. I hope I've shown you that RC-135 duty is the Air Force as advertised. If your curiosity is piqued, even a little, then call the 38 SRS, AV 271-3319, and speak with any navigator. I'm betting that your call will confirm my claims. The RC-135 isn't a special duty assignment, but it should be. It's just that good!

A graduate of the University of Rhode Island, Capt Falvey was commissioned via OTS in 1976. Following UNT and KC-135 CCTS, he was assigned to Fairchild AFB. He received his MBA from Gonzaga University. Assigned to Offutt AFB since 1981, Capt Falvey is an RC-135 navigator instructor.

RAVEN HAVEN-
THE MAGICAL MYSTERY TOUR

Major John J. CABAN
343 SRS
Offutt AFB, NE

Let your fantasies flow. Imagine yourself invisibly gliding through the bright-blue haze of your squadron building. It's clear and a million. The majors' board results were just released and the squadron commander is congratulating two of his troops. One was promoted three years below the zone and the other two years early. You think your ears are deceiving you. Such fortune rarely exists in one squadron. Now your eyes must be going too—all three of these officers wear navigator wings!

Dizzy and spatially disoriented, you get clearance for a lower altitude and descend to the relative calm of the squadron DO's office. You quickly spot the operations officer busily discussing OERs with the flight commanders. You're feeling better, breathing easier and pulse rate is returning to normal, when you notice that everyone in that office is a navigator!

You're now flying inverted in full-blown vertigo. Instinctively you squawk emergency and rapidly descend for an approach to the squadron lounge, right in the midst of an impromptu mission review. Sanity at last! You loosen your frantic grip on the joystick and mop your brow. Now, you join in tight formation with the true professionals, the guys who guide the crews, the heart and spirit of any squadron—the crew commanders. Approaching the high fix in echelon cells, you gaze down in amazement to find that it's happening again. Above the left breast pocket of every crew commander—navigator wings!

In the last seconds of a death spiral, as you descend to your destiny, two explanations for your surrealistic visions come to mind. First, if hallucinating, perhaps the squadron coffee was spiked? Or second, maybe you did see an entire navigator-rated squadron. Perhaps there is an operational squadron in which the commander, operations officer, flight and crew commanders, indeed the entire squadron, all wear navigator wings. Where are you? What year is it—2001? Well, it's today and the squadron in question is the 343d Strategic Reconnaissance Squadron (SRS) at Offutt AFB, Nebraska.

Ravens review mission profile. Pictured are (from left): Maj Mark Smith, Capt Nolan Mackness, Maj Bob Wysong, and Capt Randy Timmons.

The 343d is comprised of a diversified blend of young tigers and old heads who, in conjunction with the 38th Strategic Reconnaissance Squadron (SRS), fly various models of the RC-135 aircraft. Affectionally known as "Raven Haven," the 343d is manned entirely by Electronic Warfare Officers who enjoy some of the very best flying and TDY imaginable. We also work with some of the best state-of-the-art equipment. What background do the "Ravens" come from? Well, the "young tigers" generally are assigned to the 343d upon graduation from Electronic Warfare Training (EWT), at Mather's 453d Flying Training

Squadron. Some lucky UNT graduates are tagged as RC-135 Electronic Warfare Officers, even before entry into EWT. The "old heads" usually come from three sources: rated supplement jobs, B-52 EW tours, or prior RC-135 Raven service.

My background includes both of the first two categories. From experience, I've made two striking observations since joining the 343d. First, job satisfaction is everywhere. I've yet to find a Raven who believes his current job isn't the best. That's a strong hint that the squadron staff must be doing things right. Next, the diverse talent in both the 343d and the 38th, which does the piloting and navigating, is simply amazing. This talent isn't just restricted to flying skills—it includes sports, hobbies, anything you might imagine.

TDY and flying time amassed during a 343d tour will vary with aircraft type, individual desire, and mission requirements. Generally, 125 days and 800 hours, respectively, are the rules of thumb. An eager, globe-trotting bachelor could boost those numbers considerably.

Now for a word about job opportunities and follow-on assignments for the 1575L AFSC. You'll never have to worry about getting another good assignment after your tour with the Ravens. A continuing 1575L staff officer requirement exists. For this reason, the average 343d tour is about two years. Air Force needs are that great. It's a nice feeling to be in such demand.

Many ask about specific RC-135 aircrew tasks and aircraft configurations. The number of Raven positions on our different aircraft models depends entirely upon mission requirements and...bump...ouch! Sorry, I just hit the proverbial green door which gives our job that aura of magic and mystery. Even though mystery remains a part of our modus operandi, you'll find plenty of substance in the Raven Haven. If you're a new or old "crow" who wants a super tour with immediate job satisfaction and career progression, the best equipment, people, flying, and TDY, give the 343d a try. Hey, speaking of magic and mystery, I just saw this guy gliding through the bright-blue haze of the squadron building....

Maj Caban graduated from St Louis University. Commissioned via ROTC in 1970, he obtained his MS in Mathematics from Southern Illinois University, Edwardsville. After UNT and EWT, he served at Carswell AFB until assigned to HQ SAC/XO in 1979. Maj Caban now is a Raven Flight Commander.

Offutt's 55th Strategic Reconnaissance Wing

The 343d SRS shares a proud part of the 55th Strategic Reconnaissance Wing's colorful history. The 55th traces its richly textured heritage back through more than 40 years of distinguished, decorated service. From its role as a World War II pursuit fighter group, to its current mission as one of the premier electronic intelligence gathering units under national command authority, the "Fighting 55th" has evolved into four separate flying squadrons—each boasting its own top-notch personnel and aircraft. These squadrons are:

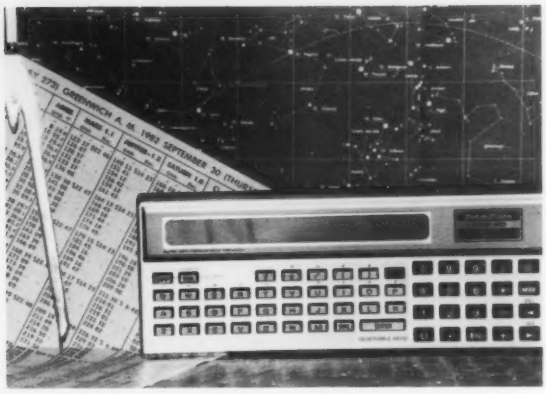
The 1st Airborne Command and Control Squadron (ACCS) flies the E-4 National Emergency Airborne Command Post (NEACP, pronounced "kneecap").

The 2d ACCS flies the EC-135 Looking Glass—SAC'S airborne command post.

The 38th SRS, one of the first squadrons assigned to the 55th SRW, on 1 April 1979, was reactivated to receive pilots and navigators from the 343d SRS. The 38th flies the RC-135.

The 343d SRS, known to EWOs as "Raven Haven," consists entirely of Electronic Warfare Officers who fly the RC-135 strategic reconnaissance aircraft.

Put the STARS in your pocket



Captain Richard E. VAN LOMMEL
323 FTW/DOTI
Mather AFB, CA

How would you like to accurately complete a three-star celestial precomputation in only two minutes? Thanks to the TRS-80 Pocket Computer, and others like it, you can—quickly and without the extraction errors commonly associated with the HO 249 Sight Reduction Tables. As a matter of fact, the computer resolves those easily-forgotten rules of LHA less than 180 degrees, the pitfalls of contrary vs same, and even performs the sexagesimal addition and subtraction. It does all this without your even opening the HO 249s. However, you still need a current Air Almanac.

10

USING THE PROGRAM

To make the TRS-80 work for you, first insert the program exactly as shown in the program listing. With the program loaded, you next select one of two units of angular measurement—degrees or radians. Set the angular symbol to DEG, for degrees, and press the mode key to put the computer in the define (DEF) mode. Then, press SHIFT C to execute the program. The title, Cel Navigation, will appear in the display for one second followed by LAT(+N/-S)=. Enter the value for your real (versus assumed) dead reckoning latitude at fix time. Degrees are entered as a whole number, while minute entries are preceded by a decimal point. For example, N38-33 is entered as 38.33. If your DR latitude is Southern, such as S22-45, precede the value with a minus sign: -22.45. As with all computer inputs, check the data before pressing the ENTER key. If you do key incorrect data, simply press CLEAR and key in the correct information. Once you press ENTER, however, the data is stored and cannot be revised without entering the entire program again.

```
 5:"C"PAUSE "
    CEL NAVIGA
   TION"
10:INPUT "LAT(+
   N/-S)="$A,"L
   ONG(+W/-E)="
   $B,"GHA="$C,
   "DEC=(IF STA
   R, ENTER 0)"
   $D
20:A=DEG A,B=
   DEG B,C=DEG
   C,D=DEG D
30:E=C-B,F=INT
   E,G=F+.5
40:IF E>GLET F=
   F+1
50:D=C-F,M=INT
   A,M=M+.5
51:IF A>=MLET A
   =M+.5
52:A=INT A
60:H=DMS B,I=
   DMS A
70:L=C-B
80:IF L<0LET L=
   L+360
90:PRINT "ASM L
   ONG="$USING
   "####.##"$H
100:PRINT "LHA
    ="$USING
    "####.#"$L
110:PRINT "ASUM
   LAT="$USING
   "###"$A
111:W=L
112:"S"INPUT "ST
   AR # IS(SUN=
   0)?"$U
113:IF U=0GOTO 1
   20
114:L=W+DEG (A(U
   ))
115:IF L>360LET
   L=L-360
119:D=DEG (A(U+1
   ))
120:J=ASN (SIN A
   *SIN D+COS A
   *COS D*COS L
   )
125:J=DMS J,J=(
   INT (100*J+.
   5))/100
126:USING
130:K=ATN (SIN L
   /(COS L*SIN
   A-TAN D*COS
   A))
140:IF L<=180
   GOTO 160
150:IF L<=360
   GOTO 180
160:IF K>0GOTO 2
   00
170:IF K<0GOTO 2
   20
180:IF K>0GOTO 2
   40
190:IF K<0GOTO 2
   60
200:Z=180+K
210:GOTO 280
220:Z=360+K
230:GOTO 280
240:Z=K
250:GOTO 280
260:Z=180+K
270:GOTO 280
280:PRINT "HC
    = "$J
285:Z=INT ((10*Z
   +5)/10)
290:PRINT "ZN
    = "$Z
300:"M"N=15.04*4
   *COS A*SIN Z
   ,N=INT ((10*
   N+5)/10)
310:INPUT "TK= "
   $P,"GS= "$Q
320:Q=(Q*4)/60*
   COS (Z-P),Q=
   INT ((10*Q+5
   )/10
330:R=N+Q
340:S=2.62*(Q/10
   0)*SIN A+.14
   6*(Q/100)^2*
   SIN P*TAN A,
   S=INT ((10*S
   +5)/10)
350:PRINT "NGO
    ="$Q
360:PRINT "NGB
    ="$N
370:PRINT "4 MIN
    AJ="$R
380:PRINT "CORIO
   LIS="$S
381:IF U<>0GOTO
   112
390:END
```

Program Listing

With latitude entered, you next input the DR longitude (+W/-E). Using the same format as above, enter a whole number for degrees followed

by minutes of arc after a decimal point. Remember, if your longitude is east, a minus sign must precede your entry of degrees and minutes of longitude. Again, press ENTER to store the data.

The computer display will now "request" a GHA. If you are computing the stars, enter the GHA of Aries. If shooting the Sun or a planet, enter the respective GHA. Don't forget to enter a correction for extra minutes, if computing for times other than the ten minute increments of GHA given in the Air Almanac. You can either add the extra minutes of GHA mentally or enter the GHA plus the correction as follows: 292.19 + 1.15. After pressing ENTER, the computer will combine the two values and store the sum as total GHA.

The next item to enter is declination (+N/- S). If precomputing the stars, enter 0 (zero). If fixing on the Sun or a planet, simply enter the body's corresponding declination. Once again, press ENTER to store the data.

With this step complete, the computer performs its calculations as illustrated in Figure 1. Through each step, degrees and minutes of arc are automatically converted into decimal values. As the computer continues to run, it calculates the assumed position for an even LHA. A few seconds later, it displays assumed longitude. This value will be displayed until the operator presses the ENTER key. Pressing ENTER once more displays assumed latitude.

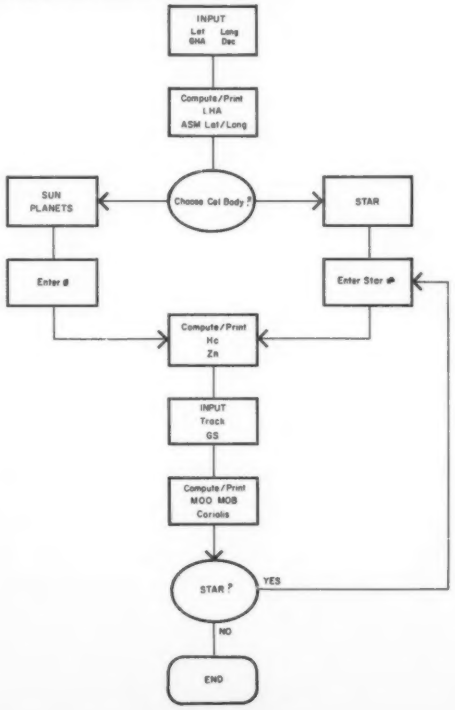


Figure 1

When the ENTER key is pressed again, the computer "requests" a star number. Simply enter the corresponding number from your star data library. (Instructions on programming the stars follow in this text). If you're shooting the Sun or a planet, enter 0 (zero). For the next five seconds, the display is blank as the computer performs some very complicated calculations. When completed, the Hc and Zn of the selected star appear on the display. At this point, your precomp is complete if you plan to shoot on time. You need only compare the observed sextant altitude with the Hc. Don't forget to correct the Ho for refraction and the assumed position for Coriolis/Rhumbline. Apply the HoMoTo Rule and plot your intercept.

You may prefer to shoot early, especially if fixing at night. Using a 12-8-4 minute shooting schedule, you can observe three stars and still resolve and plot your position by fix time. The computer will calculate motion of the body and the observer. It will also calculate a four-minute combined adjustment. Once you know the adjust for four minutes of motion, you need only triple or double it for the 12 or 8-minute-early total motion adjusts. The total motion adjust for any other time increment can be set up on the MB-4 computer as a ratio.

To compute motions with the TRS-80, you must again press ENTER. Next, input values for true track and groundspeed. A few seconds later the computer will display MOO, MOB, and a four-minute combined adjust. Lastly, it displays the Coriolis/Rhumbline correction. The precomp is finished for one celestial body. For night celestial, the program automatically loops back to the step requiring star number insertion. Using previously stored data, the TRS-80 recomputes new values of Hc and Zn for each successive star.

PROGRAMMING THE STARS

Instead of entering the SHA and Dec each time you precompute a star, you can store that information, assign it a number, and recall the values for each star you use. To create your star data library, store the SHA and Dec for your first selected star in memory spaces 27 and 28 respectively. Next, store values for the second star in spaces 29 and 30, and so on, until memory capacity is exceeded, as indicated by error code 4. Information is entered in the following format:

```
A(27) = 291.16    (SHA of Aldebaran)
A(28) = 16.29     (Dec of Aldebaran)
A(29) = 166.42    (SHA of Alioth)
  |     |
  |     |
A(84) = 38.46     (Dec of Vega)
```

Complete the same steps for all values in my Table 1. Table 1 data corresponds to the stars in Table 2. If you wish to program other stars, use the SHA/Dec values from the inside front cover of a current Air Almanac. Notice that Aldebaran in my table is identified by #27, which may not correspond to the star number in the Air Almanac. You should update the SHA and Dec semiannually with each Air Almanac revision.

Information stored in the computer can be transferred to a cassette tape using the PRINT # instruction. The PRINT # instruction tells the computer to record memory contents on magnetic tape. You must designate a "file" name prior to recording memory data. The "file" name permits future access to stored data. I designated mine "SHA." To print a permanent record, execute in the DEF or RUN mode as follows:

PRINT # "SHA"

Once data is on tape, it may be transferred back to the computer with the following instruction:

INPUT # "SHA"

The main program must be inserted into the computer before inputting the data file.

SAMPLE PROBLEM

Let's try a sample problem. After turning on the computer, make sure it is set to the DEF mode and then press SHIFT C. For this problem, assume DR coordinates of N37-44, W112-16. Your GHA of Aries for a 0450 fix is 291°-25'. Track and groundspeed are 350° and 440 knots respectively. You plan to shoot Kochab and Spica. Now work your precomputation.

INPUT	DISPLAY
Lat (+N/-S) = 37.44	
Long (+W/-E) = 112.16	
GHA =291.25	
Dec (for star, enter zero) = 0	ASM LONG = 112.25
	LHA = 179
	ASM LAT = 38
Star # is (Sun = 0)?	Hc = 48.22
	Zn = 016
TK = 350	
GS = 440	MOO = 26
	MOB = 13
	4 min adj = 39
	CORIOLIS = 7R
Star # is (Sun = 0)?	Hc = 36.46
	Zn = 153
TK = (press ENTER since TK & GS are same as above)	MOO = -28
	MOB = 22
	4 min adj = -6
	CORIOLIS = 7R
Star # is (Sun = 0)? (enter next star)	

Figure 2

If your answers agree with Figure 2, congratulations. If they do not, check your program again. You may have omitted a comma, reversed a plus or minus, or entered a zero where the letter O is required. If you cannot find your error, send me a good quality blank cassette tape and I'll record the program for you. Address your request to Captain Rich Van Lommel, 323 FTW/DOTI, Mather AFB, CA 95655.

```
SHA/DEC LISTING

MEM 27. 291.16
MEM 28. 16.29
MEM 29. 166.42
MEM 30. 56.03
MEM 31. 153.18
MEM 32. 49.24
MEM 33. 218.19
MEM 34. -8.35
MEM 35. 126.31
MEM 36. 26.47
MEM 37. 358.08
MEM 38. 29.
MEM 39. 62.31
MEM 40. 8.49
MEM 41. 112.55
MEM 42. -26.24
MEM 43. 146.17
MEM 44. 19.17
MEM 45. 271.27
MEM 46. 7.24
MEM 47. 281.09
MEM 48. 45.59
MEM 49. 49.47
MEM 50. 45.13
MEM 51. 349.19
MEM 52. -18.05
MEM 53. 182.58
MEM 54. 14.4
MEM 55. 194.21
MEM 56. 61.51
MEM 57. 34.1
MEM 58. 9.48
MEM 59. 15.5
MEM 60. -29.43
MEM 61. 328.27
MEM 62. 23.23
MEM 63. 137.2
MEM 64. 74.14
MEM 65. 314.39
MEM 66. 4.01
MEM 67. 309.14
MEM 68. 49.48
MEM 69. 243.56
MEM 70. 28.04
MEM 71. 245.24
MEM 72. 5.16
MEM 73. 96.28
MEM 74. 12.34
MEM 75. 208.09
MEM 76. 12.03
MEM 77. 350.07
MEM 78. 56.27
MEM 79. 258.54
MEM 80. -16.41
MEM 81. 158.56
MEM 82. -11.04
MEM 83. 80.55
MEM 84. 38.46
```

Table 1

STARS	NAME
27/28	ALDEBARAN
29/30	ALIOTH
31/32	ALKAID
33/34	ALPHARD
35/36	ALPHECCA
37/38	ALPHERATZ
39/40	ALTAIR
41/42	ANTARES
43/44	ARCTURUS
45/46	BETELGEUSE
47/48	CAPELLA
49/50	DENEB
51/52	DIPHDA
53/54	DENEBOLA
55/56	DUBHE
57/58	ENIF
59/60	FOMALHAUT
61/62	HAMAL
63/64	KOCHAB
65/66	MENKAR
67/68	MIRFAK
69/70	POLLUX
71/72	PROCYON
73/74	RASALHAGUE
75/76	REGULUS
77/78	SCHEDAR
79/80	SIRIUS
81/82	SPICA
83/84	VEGA

Table 2

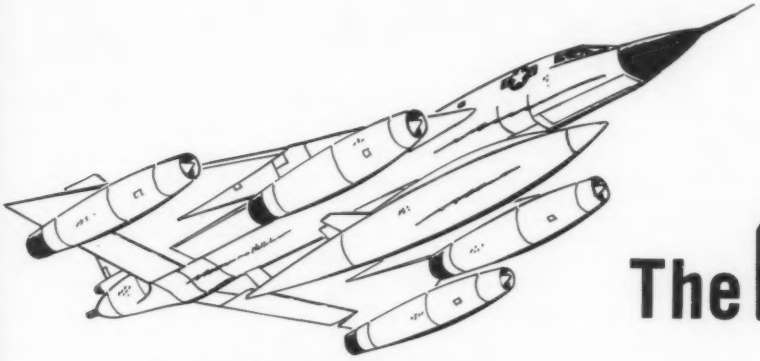
SOME FINAL COMMENTS

This program has some very nice built-in options. Sometimes it's more accurate to recompute motions using track and groundspeed which occur during the time of your observation. By pressing SHIFT M, you can access the program in midcourse. This permits you to

recompute motions with revised values of GS and TK. Press SHIFT S and the program will loop back to the star # input step. With this function you bypass the motion subroutine altogether.

The TRS-80 can give you perfect precomps. It "requests" all data required for each calculation. Answer these requests carefully. Although the computer is fast and accurate, incorrect inputs mean incorrect outputs. Check and double check all data before entry. With the TRS-80 and a little care, you will have many happy precomps and will always find the stars right in your pocket.

Capt Van Lommel obtained a degree in Electrical Engineering from California State University, Long Beach. After completing UNT in 1974, he was assigned to the C-141 at McGuire AFB. Capt Van Lommel has served at Mather AFB since 1979.



The B-58 Hustler

Captain Walter W. WOODRUFF
34 TTS/TTD
Little Rock AFB, AR

The Winter 1982 issue of THE NAVIGATOR contained a very good article about the Convair B-36—truly a magnificent aircraft. The B-36 made its first flight in 1946, and just ten years later another Convair-designed bomber took to the air on its maiden flight. This aircraft, however, represented a quantum leap in the development of aeronautical structures, systems, and performance. I'm describing the B-58 Hustler, one of the most advanced aircraft ever to fly. Compared with its piston-engined forebearers, the '58 represented a four-fold speed increase, extremely sophisticated avionics, and overall performance exceeding most of the fighters of its era.

Just a glance at the photos tells you that the B-58 was quite a bird—it looks like its going Mach 2 just sitting on the ramp! In flight, by the way, it could go Mach 2 plus, fly from Los Angeles to New York in two hours, and reach altitudes above 85,000 feet. Performance like that is still excellent by 1983 standards; in the late 1950s it was almost unbelievable. One of the most noteworthy aspects of the B-58 was its crew composition—one pilot, one navigator, and a defensive systems operator. More on that shortly.

The concept of the B-58 originated in the late 1940s with a program called GEBO—GEneralized BOmber. By 1952 the early design had evolved into a four-engine, supersonic bomber carrying a three-man crew. Packed with advanced avionics, it could fly anywhere in the world and bomb with

precision. The General Dynamics Corporation (Convair) at Fort Worth, Texas, was awarded the B-58 contract in November 1952. Production development began shortly thereafter. Convair made many major airframe advances during the B-58's construction, including perfecting the honeycomb fuselage skin pattern to provide great strength with minimum weight. The design goal of a Mach 2 dash capability made many unique demands of engines, avionics, cooling systems and airframe. When it rolled out of the factory, in the autumn of 1956, the B-58 was a compact, high-density aircraft, packed with electronics, powered by four J-79 jet engines (the same used in the F-4) and equipped with a unique under-fuselage pod to carry the warhead and extra fuel.

From 1956 until 1960, the B-58 underwent extensive testing and development. It is interesting to look back from our solid-state, digital avionics world and see just how advanced the B-58's navigation systems were for its day. Seated behind the pilot in a separate compartment, the navigator had, at his command, a vast array of very special gear. The entire ASQ-42 nav system was built by the Sperry Company. It was the first astro-interial-Doppler system used operationally. Its Doppler radar, astrotracker, inertial unit, high-resolution mapping radar, and in-flight printer were combined into a complex system weighing several tons and containing over 5,000 vacuum tubes and numerous analog computers. The system was called "the greatest collection of vacuum tubes and mechanical analog machinery ever conceived and fabricated by man." Today, all of the B-58's computers and circuits could be reduced to a few computer chips, yet, in the late 1950s, the ASQ-42 was considered a fantastic achievement.

The navigator had all the information he needed for any type of mission, including present position, time and distance to go, ballistic and target data, as well as celestial data from the astro-tracker. The in-flight printer could record and print such log information as heading, fix coordinates, time, groundspeed, etc. This device was very handy, particularly when the '58 was "hustling" along at 20 miles per minute!

The purpose of all this equipment was, of course, to enable the B-58 to accurately fly to any point on the globe. That it could do so in a hurry was soon evidenced by the string of speed records the Hustler fleet quickly achieved. Some of the most notable record-breaking flights included: New York to Paris in 3 hours, 19 minutes; Tokyo to London in 8 hours,35 minutes; Los Angeles to New York and back in 4 hours,41 minutes, and a top speed of 1302 mph for a 600 mile course. By 1964, the B-58 had set 19 officially recognized world speed and altitude records—not bad for any airplane.

As advanced as it was, the Hustler was nothing without the dedicated crew members who made it work. Each crew member was isolated in his own separate compartment and could communicate with other crew members only by interphone or

with the aid of a rope transfer line. The rope transfer system was a simple conveyor consisting of pulleys, line, and a nylon bag. With it, crew members passed mission forms, flight data notes, and other small items between one another. The pilot certainly had his hands full controlling the airplane, particularly during takeoff and landing. Due to its delta wing design, the '58 whistled in over the fence at 190 knots with the nose pitched up 12 degrees. Straight-ahead vision was lost at 200 feet AGL and little time was available to compensate for landing too short or long. The navigator, seated behind the pilot in the second station, got the airplane to the target and back. The third crew member, the Defensive Systems Operator, ran the electronic countermeasures gear, read checklists, and performed a number of systems operations and flight management duties.

The first unit to receive the B-58 was the 43d Bomb Wing at Carswell AFB, Texas. The Hustler was operational by August 1960. Competition for B-58 crews was intense. In fact, over 80% of the initial SAC volunteers surrendered spot promotions for a chance to fly the Hustler. Shortly after its operational debut in September 1960, a B-58 from the 43d won the high and low level radar bombing events at the 1960 SAC Bombing Competition held at Bergstrom AFB. This was a real tribute to the B-58's fantastic systems and its highly skilled crews. For the next 10 years, the B-58 remained an integral part of SAC. The 43d BW moved from Carswell to Little Rock AFB in 1964, and the 305th Bomb Wing was transferred to Bunker Hill AFB (now Grissom AFB), Indiana in the early 1960s.

Despite its successes, the B-58 still experienced some significant operational problems. First of all, its very complex design required a great deal of expertise and money to keep it operating. The electronic systems were temperamental at first, and because of their vacuum tube design, they were prone to frequent failure. Eventually, as the maintenance learning curve progressed, the airplane became increasingly reliable. From early B-58 experiences, many lessons were learned about flying and maintaining a high performance bomber.

The Remarkable B-58: Speed, Altitude, and Payload Records

12 January 1961 — 2000-kilometer closed-circuit course at 1061.80 mph with (1) no payload, (2) 1000-kilogram payload, (3) 2000-kilogram payload.

14 January 1961 — 1000-kilometer closed-circuit course at 1284.73 mph with (1) no payload, (2) 1000-kilogram payload, (3) 2000-kilogram payload. *Thompson Trophy.*

10 May 1961 — Closed course at average speed of 1302.07 mph (2095 km/h) for more than 30 minutes. *Bleriot Trophy. This prize originally was offered 30 years earlier, by Louis Bleriot, to the first aircraft that could average 2000 km/h for 30 minutes.*

26 May 1961 — (1) New York to Paris in 3 hours, 19 minutes (average speed 1089.36 mph), (2) Washington to Paris in 3 hours, 39 minutes. *Mackay Trophy and Harmon Trophy.*

5 March 1962 — (1) Non-stop from Los Angeles to New York and back to Los Angeles in 4 hours, 41 minutes (average speed 1044.96 mph). (2) The Los Angeles to New York flight set a record of 2 hours. (3) The New York to Los Angeles time of 2 hours, 15 minutes "beat the sun" by 41 minutes. *Bendix Trophy and Mackay Trophy.*

18 September 1962 — Altitude and payload records, with flights to 85,360.84 feet carrying payload of (1) 2000 kilograms and (2) 5000 kilograms.

16 October 1963 — Five speed records on Tokyo to London flight: (1) world's longest supersonic flight, (2) Tokyo to London speed record, (3) Tokyo to Anchorage speed record, (4) Anchorage to London speed record, and (5) Tokyo to Chicago speed record.

Optimized for high speed and high altitude bombing, the B-58's appeal declined with improvement in Soviet air defenses in the mid 1960s. The Hustler performed very well at low level, but this type of flying greatly increased aircraft fatigue and decreased range. Also, the '58 lacked terrain following equipment. To modify it with such gear was deemed too expensive. By the late 1960s, the expense of maintaining the small fleet of B-58s became quite significant (only 116 airplanes were built).

Due to these factors and the toll of time, the decision was made to retire the B-58 fleet. The announcement came on 29 October 1969. By the

(continued on page 30)

Lieutenant Colonel Richard E. HANSEN, USAF Retired

IDEAS, Inc
Prattville, AL

Picture yourself as the world's greatest navigator. Got that? Okay, now stand a little straighter, you'll have to look the part. How about assuming a far-away gaze as if searching for distant shores? Too dramatic? You're right. Better refocus your view. Assume you're an early European explorer or Roman warrior struggling to find your way through uncharted territory. Look carefully at the white, unmarked surface of the globe standing before you. How might you devise and number a system of reference lines on this unoriented, curved model of your planet? You scratch your head. Where will you draw the first line?

Actually you are Claudius Ptolemaeus, and you pace the floor of your study in Alexandria at the mouth of the Nile around 150 A.D. Today, we know Claudius Ptolemaeus as Ptolemy, the great geographer. Though he worked in Egypt, he was a Greek who probably gravitated to that early Christian center of knowledge to study in the Great Library at Alexandria. In Ptolemy's day, Greek influence pervaded even to the southern shores of the Mediterranean. The great scholars of the Golden Years of Greece– Hipparchus, Strabo, Eratosthenes, Poseidoneus, and other astronomers–contributed heavily to describing the earth in scientific terms.

The notions of latitude and longitude were still seminal concepts when the Greeks, having absorbed the accumulated knowledge of the ancient Babylonians and Chaldeans, turned their attention to their study. It was from the Tigris-Euphrates cultures that our sexagesimal (sixty-based) numbering system most likely derives. Well-educated citizens, usually the priests, became enamored of the six and sixty-based systems. Although cognizant of the decimal/centesimal systems, they still favored the sexagesimal, perhaps due to their deep roots in religion and superstition. Historians speculate that their ancient proclivity explains today's habit of measuring arcs and counting time in 60s. Six times 60 yields the circle of 360 units and the system of chords, again twice divided into 60 equal parts, to which Ptolemy subscribed. The Latin translations of these subdivisions are *partes minutae primae* and *partes minutae secundae,* from which come our modern "minutes" and "seconds" of arc and time.

Unfortunately, Ptolemy's written works, *Almagest* and *Geographia*, were lost during the blind, anti-scientific religious fervor of the Dark Ages. However, his ideas surfaced again in the Renaissance. In 1561, following the invention of printing, a Venetian editor attempted to recreate a map of the world as described by Ptolemy. Latitude on that early grid-like map was expressed by bands of numbers indicating duration of sunlight, in hours, on the longest day. These bands were labeled climata or weather zones. Lines of longitude were represented in fractions of hours east of the Fortunate Islands. Known today as the Canaries, these islands represented the western edge of Ptolemy's world. It was natural then that the Fortunates were used as his "benchmark" for longitude or prime meridian.

None of this implies that Ptolemy did not eventually use degrees of arc to describe latitude. He eventually did. In fact, he invented an astronomical device to measure latitude. The device included a flat vertical stone with a quarter circle inscribed on its face, and a zero degree line on the horizontal plane. A 90 degree line pointed to the celestial zenith. The sun's shadow was traced by a horizontal pin protruding from the convergence point and the plane of the device, adjusted to high noon. With this instrument, Ptolemy measured, in degrees, the variance of the

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Early maps were referenced to lands in Eastern Asia, the Orient, hence the term orientation. Note the "orientation" of this map depicting Ptolemy's benchmark for longitude—the Fortunate Islands.

sun's angle between the summer and winter solstices. This angular difference he determined to be 47 degrees, 40-45 minutes. Knowing this angle to be the arc between the two tropics, Ptolemy deduced that the Equator lay midway between. This made the angle of tilt to the ecliptic about 23 degrees, 50-odd minutes. From this, Ptolemy further reasoned that an observer could measure his latitude in degrees north of the equator by computing the midpoint of angular readings. One glaring drawback to this procedure was that the observer had to keep the instrument stationary for at least six months!

During Ptolemy's time we know that the concepts of an Equator and the sun's annual migration between the tropics were well known. Additionally, that other limit of the sun's migration, the arctic circle, was known. The arctic circle was recognized because it was where the Great Bear constellation (our Big Dipper) rotated continuously above the horizon. The sun and the stars provided early visual manifestations of parallels of latitude. Slowly, however, the theoretical concept of parallel lines circumscribed around the earth's poles became popular.

Ptolemy, whose writings have survived, quoted often from writings of Marinus of Tyre, whose works were lost. Marinus' works were available in the library at Alexandria, and Ptolemy studied them at length. He tells us that Marinus had located the areas of the habitable world in "degrees" north of the equator, on a meridian circle divided into 360 units. How did Marinus arrive at 360 divisions of the great circle meridian?

No documents of the ancients have yet been discovered to fill this gap in history. Again, speculation explains the selection of 360 divisions as a legacy of the priests of Ur in Mesopotamia who, for centuries, tracked the stars, planets, sun, and moon. Their priestly duties likely included interpreting the positions of heavenly bodies in relation to earthly events. Hence came their eventual division of the ecliptic into twelve equal parts (the zodiac), and each again into 30 equal parts. Probably this construct was just coming to fullest flower when Ur was flooded and destroyed by a change in the river course at about five centuries B.C. Some future archeologist may unearth some clay tablets or copper scrolls, that survived the freezes and thaws of their desert resting place, to enlighten us and bridge our gap of knowledge. Somehow, knowledge from Ur still flowed between Asia and Europe and later became available to Marinus studying at Tyre.

Marinus may deserve a great deal of credit for advancing the scientific knowledge of his day, but Ptolemy often criticized his contemporary. He pointed out that Marinus had separated the latitude of a place from its longitude on different pages of his texts. Ptolemy gave special attention to "an improved method" of fixing political boundaries in his maps so that latitude and longitude were set down together and could be seen at a glance. This sounds terribly obvious to us today but was a novel concept in the nascent arts of map-making and geographical referencing.

That the earth is a sphere had to be rediscovered later, but to Ptolemy it was an

— our geographical reference system

accepted fact. "When the earth is delineated on a sphere," he wrote, "it has a shape like its own, nor is there any need of altering it at all." His recommendation: "Having selected a sphere of suitable size and having determined the positions of the two poles, the globe should be suspended between two pivots and connected by a semicircle. This semicircle should lie a little distance from the surface, almost touching it, and be divided into 180 parts numbering from the equatorial line and working in both directions. In the same way, the equinoctial line should be graduated and the numbering should begin at the westernmost meridian passing through the Fortunate Islands."

Ptolemy faced that same white, unsullied globe you figuratively contemplated in the opening paragraph. With the knowledge of his predecessors and his own genius, he helped perfect a geographical reference system. His reference lines have survived virtually unchanged to this day. We still use his 180 degrees of latitude with 90 degrees north of the equator and 90 degrees south, but something has happened to his placement of the longitudes. No longer do the Fortunate (Canary) Islands retain the honor of marking the prime meridian. In fact, it was the difficulty of determining longitude, by celestial or any other means, that eventually caused the zero-degree meridian to be relocated.

The precise determination of longitude continued to elude navigators and geodicists even into the days of the great explorers. Pigafetta, who sailed with Magellan, reported that the great mariner spent many hours studying the problem of longitude. In 1493, Pope Alexander VI, with reckless aplomb, issued his Papal Bull establishing a Demarcation Meridian through a point one hundred leagues west of the Azores. This act gave all discoveries west of the line to Spain and all east of it to Portugal. However, one drawback was that no one could accurately locate that meridian at sea.

In 1598, Phillip III, of Spain, offered a perpetual pension of 6000 ducats to the "discoverer of longitude." The King was deluged with wild and impractical ideas but some held promise. In 1616, an Italian named Galileo offered a solution, based on the moons of Jupiter,which so bored the King that he shrugged the whole thing off. Portugal and Venice offered rewards, as did Holland. In 1636, Galileo again offered his upstart solution. He told the Dutch about observing the moons of Jupiter and noting that their eclipses created an excellent celestial timekeeper. Time was the key to determining longitude. Galileo offered detailed tables depicting the movement of Jupiter's moons by which any mariner could determine his local mean time (LMT). With LMT and the time at another known location, he could then calculate his longitude. The Dutch found Galileo's method sound and awarded him a gold chain. However, he was denied his full reward due to intervention by the Vatican. Further development of Galileo's method was prevented and he died in 1641.

Oddly though, it was Galileo who contributed to the eventual solution of the longitude problem with his study of the nature of pendulums. In 1556, Christian Huygens built the first pendulum clock to improve the accuracy of his astronomical observations. Using Huygens' timepiece, longitude could now be precisely determined. Still

there were limitations. Though a practical instrument on land, Huygen's clock was useless on the rolling sea.

While the world awaited the invention of a timepiece needing no pendulum, an Italian named Cassini built a powerful telescope and turned it toward Galileo's favorites, the moons of Jupiter. After 16 years of patient observation, he completed a table of lunar eclipses called Ephemerides. His tables were put to practical tests at locations as far away as Martinique and found workable. The Ephemerides were eventually—though reluctantly—adopted for use by foreign mariners. They were even published in the *Nautical Almanac* of England, remaining in good standing for many years. Still, the search for an improved, all-weather method of determining longitude continued.

After the loss of 2000 men and four Admiralty ships which ran aground while circumnavigating the Scilly Islands in 1714, the British Parliament offered "a publick reward for such person or persons as shall discover the Longitude." For a device that could determine longitude within one degree, £10,000 was offered; within 40 minutes, £15,000; and within 30 minutes (2 minutes of time or 30 nautical miles), £20,000. These awards were huge sums in those days. The prizes remained unclaimed for fifty years!

Finally, a mechanic and clock-builder named John Harrison emerged with a radical design. He introduced his device to the Board of Longitude in 1728, but obtained only a loan. Still, it was enough for him to continue his work. In 1735, after seven years, he completed his chronometer. Weighing a mere 72 pounds, its ingenious mechanism consisted of a system of counterbalances and an unusual "grasshopper" escapement of his own invention. The Board favored him with a test at sea, which was a success, but internal politics of Board members prevented his just reward. Harrison was sent away to "perfect" his machine with a nominal £500 for expenses. Certain Board members, who resented a rude country mechanic's intrusion on the provinces of gentlemen of high station and education, hoped to never see the clock builder again.

Harrison was to build several more chronometers, each of greater accuracy and complexity but still more compact than the last. Number four, only five inches in diameter, was truly a beauty of design and finish. The Board of Longitude, after much consternation, gave the fourth design a sea trial. Even though the chronometer kept near-perfect time and allowed an ocean crossing landfall within 28.5 miles, clearly qualifying for the highest prize of £20,000, Harrison was put off again. At the age of 75, weak of eyesight but armed with design number five, Harrison applied for the prize again. Only with the final intervention of the King was Harrison given proper reward for having "discovered the Longitude." The final gap between a theoretical and a practical geographical reference system was bridged—a process spanning centuries.

Of course, with these many tests employing London as the starting point, it is not surprising as to where the zero-degree meridian was redrawn. The British placed it through the site of their Royal Observatory at Greenwich, on the Thames River. Some other countries were not excited over the idea, notably France and Ireland. Eventually, however, they came around. It took from Ptolemy's era, in the second century A.D., until the middle of the eighteeth century, for the Prime Meridian to be relocated from the Fortunate Islands to Greenwich, England. Then, the act was largely due to the genius of a country mechanic named John Harrison. With that final step, the establishment of the Greenwich meridian, our sexagesimal system for longitude became universal.

But hold on! Nothing is forever! With the advent of highly accurate navigational systems such as Doppler, Loran C, and inertial, subtle and incremental changes in referencing are taking place today. Cockpit readouts for modern avionics systems favor decimal displays for fractions of minutes of latitude and longitude. The traditional "seconds" are out. With satellite position fixing at our doorstep, accuracies of a few meters, coupled with the microcomputer's economy of language, make more changes inevitable. These and other imperatives may cause a full transition to decimal/centesimal expression of geographical coordinates. Dare we supercede the ancients? Is it time to cast aside the superstitions of the priests of Ur?

Lt Col Hansen, USAF Retired, received his BA from the University of Minnesota and his MA from Syracuse University. He earned his rating as a pilot in 1943 and as a navigator in 1956. Piloting fighters, bombers, and airlift aircraft, he flew in three wars during his 35-year career. Published frequently in military journals, he served as Associate Editor of the AIR UNIVERSITY REVIEW until his retirement in 1977. Col Hansen now is a free-lance writer.

BACKING UP THE APPROACH

Captain Gregory L. TEMAN
4007 CCTS
Plattsburgh AFB, NY

Glance at the approach plate for the HI-TACAN to RWY 3L at Yuma MCAS (Fig. 1). The proper time to take a good first look at this approach is not when you are flying in the weather at night and 10 minutes out from RADOS IAF. Approach plate study and planning should be done during mission planning. Most of what I'll say in this article probably won't be discussed in your annual TERPS refresher class, but it is still important and should help you fly approaches more smoothly and safely. I'll discuss hitting the IAF, holding, penetration, final approach, and, lastly, landing or going missed approach.

The first step in flying a smooth approach is to get to where it starts—the initial approach fix (IAF). After completing a high bomb run, celestial navigation leg, or intercept training sortie, an approximate heading to point the aircraft in the general direction is sufficient. Next, after cleaning things up from your previous activities, take a fix, compute a precise heading, and update it as you near the IAF. Using a feeder fix will start you in the right direction, but be careful. As in the HI-TACAN or ILS/DME RWY 23 to Fairchild AFB (Fig. 2), not all feeder fixes lead you to the IAF. Ensure you have selected navigation aids for the IAF at which your planned approach begins. If you planned to fly the HI-TACAN to RWY 3L at Yuma MCAS (Fig. 1) and you tuned to the Bard VORTAC for navigation, you could mistakingly fly to the Bard R-340/43 DME instead of the correct fix off the Marine Yuma TACAN. Always double check your navigation aids!

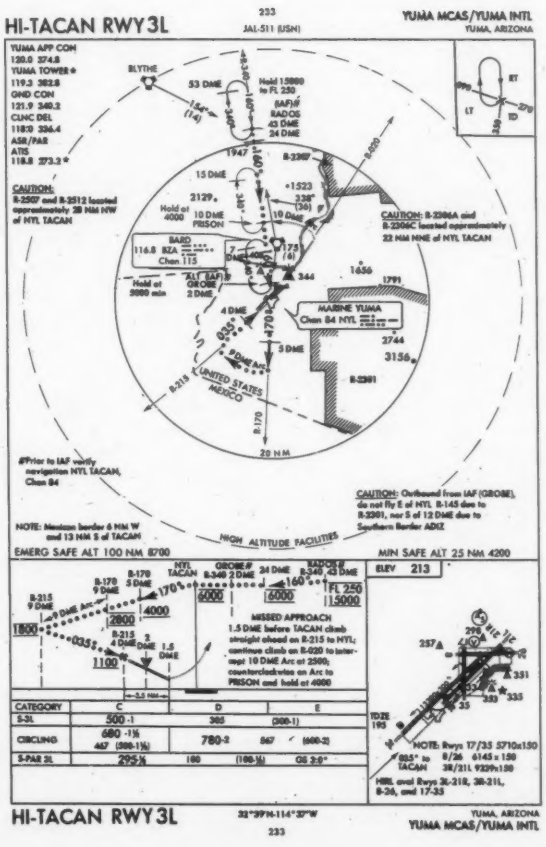


Figure 1

Another problem seen occasionally is that of non-collocated initial approach and holding fixes, as in the HI-PAR 3 to RWY 34 at Lajes AFB (Fig. 3). Your approach clearance can be misleading. If you filed to a holding fix and were cleared to fly the approach, without an amended clearance you must proceed to the IAF *via the holding fix*. But, and this is important, if the IAF is along your route of flight to the holding fix and you are cleared to fly the approach, you are expected to begin the approach upon arrival at the IAF. If you doubt what you are to do, ask the controller!

Now, you're well on your way to the initial approach/holding fix and setting up for your approach. Before reaching the fix, determine the best way to enter the holding pattern. High instrument approaches to CONUS fields normally have a holding pattern entry diagram depicted. If you are comfortable with the diagram, use it. If you're holding for a low altitude approach or landing at a field with no holding entry diagram depicted, it pays to know some entry techniques. The pros and cons of different techniques for entering holding could constitute an entire article. I recommend that you read AFM 51-37, Chapter 5, which describes, in great detail, some techniques for entering holding. Remember, unless you are cleared otherwise, three minutes before reaching the holding fix you must slow to the maximum holding speed for your aircraft as stated in FLIP General Planning and AFR 60-16. One last item to keep in mind about holding entry concerns the length of the pattern legs. If your holding pattern has legs of a specified length, fly it as depicted. If the pattern does not depict leg lengths, use timing (one minute legs at or below 14,000 feet MSL and one and one-half minutes above 14,000 feet MSL). Timing applies to the inbound leg, so adjust your outbound time to ensure that you meet the established criteria. If you've just finished a busy portion of your flight, take time in holding to get squared away so you

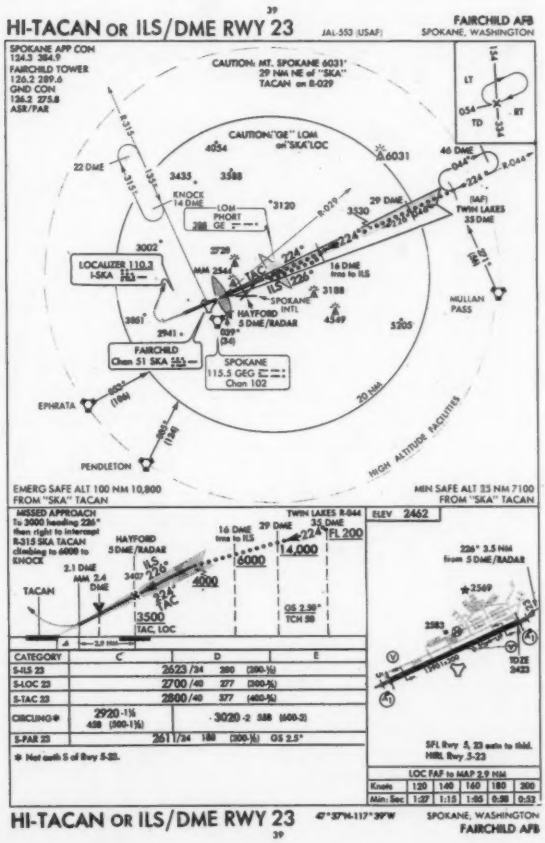


Figure 2

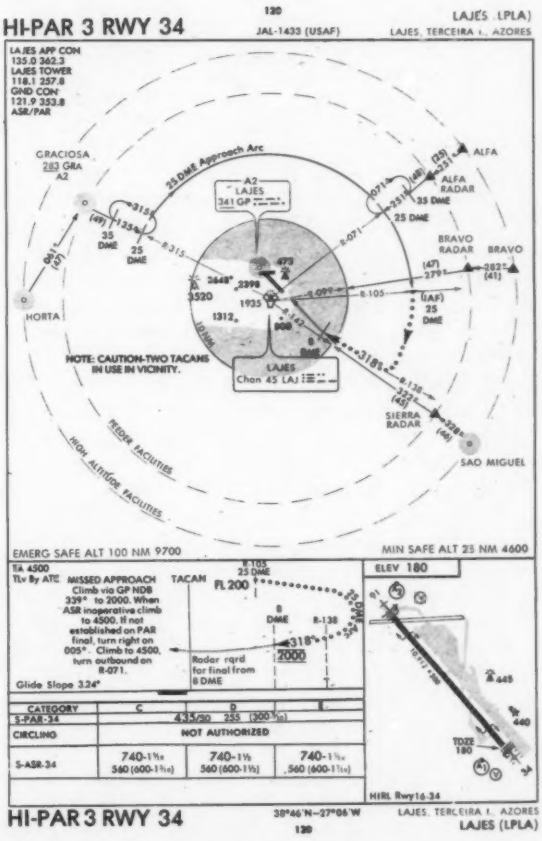
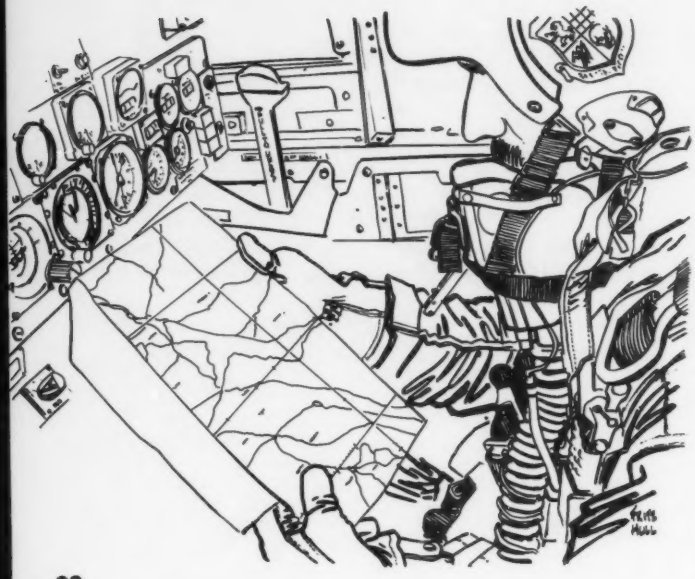


Figure 3

can devote your undivided attention to the approach. Use holding patterns to your advantage—don't start the approach until you're ready.



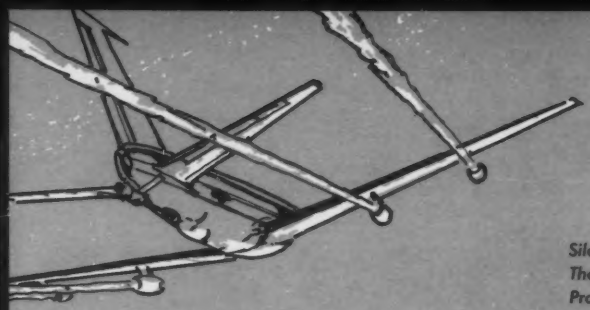
Once cleared, all of your efforts should be directed toward flying the approach correctly and scanning for other traffic. Again, check your navigation aids to ensure you have the proper stations set. Be especially wary if you were holding off a navigation aid different from the one on which the approach is built. As you start down, have a target descent rate in mind. AFM 51-37 outlines basic procedures for determining vertical velocity (ft/min) that you may find helpful. Talk with your pilots about their personal techniques and procedures. On the HI-TACAN or ILS/DME RWY 23 to Fairchild AFB (Fig. 2), should the pilot determine one descent rate to use from 35 DME to 16 DME or divide it into two separate descents, one from 35 DME to 29 DME and the other from 29 DME to 16 DME? Once you have determined a rate of descent, how will you maintain it? Know the approximate rates of descent with various drag devices, i.e., gear, speed brakes, flaps, and combinations of these devices. One final word on the penetration—on any approach with a dead reckoning (DR) course segment, you must try to fly the depicted ground track. Correcting your heading for wind or computing a point-to-point are two easy methods for staying on the depicted course. Obstacle clearance, the name of the game, is not guaranteed unless you stay on course during the penetration.

As you transition from penetration to the final approach, consider several things. Corrections to aircraft heading and altitude should become smaller and smaller, so any required large change might indicate that your approach is not going as planned. Determine a rate of descent for final approach. Normally, it will be be less than the rate of descent required during the penetration. Provide drift information to help the pilot maintain course. If your missed approach point (MAP) is defined by timing, use actual groundspeed to compute time to the MAP. Since you already know heading, drift, and groundspeed, note your true airspeed and use it with the other data to keep track of changing winds. If you detect a wind shear, a significant change in the wind's velocity or direction, tell your pilot! Know the missed approach procedures. If you must execute a missed approach, after you've hit the MDA is not the time to be fumbling through the approach book for the correct procedure.

Make one last check prior to landing—a safety check. Ask yourself some important questions. Are you cleared to land? Gear down? Flaps set? Engine instruments checked? Runway clear? If things are in the green, you need not say a word, but if not, that is the time to holler!

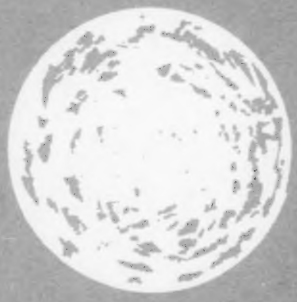
Although you're not handling the controls, you are equally responsible for correctly flying the approach. The things we've discussed should be reviewed with your crew during mission planning, but don't stop there. Discuss what you, the navigator, can do to help—actions like calling altitudes, monitoring basic instruments, and making radio calls. The list is endless! A concerted effort by you and your crew can make your approaches smooth and safe. Every time you fly you should be backing up the approach.

Capt Teman graduated from the USAF Academy with a degree in Computer Science. After UNT in 1978, he was assigned to the KC-135 at Fairchild AFB. Capt Teman now serves as a KC-135 navigator instructor at Plattsburgh AFB.

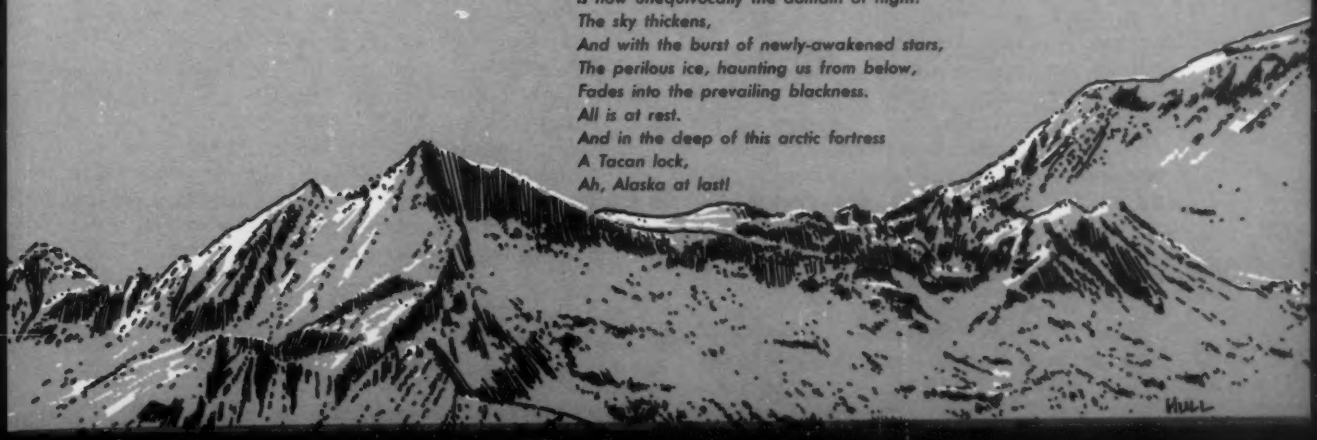


OVER THE TOP

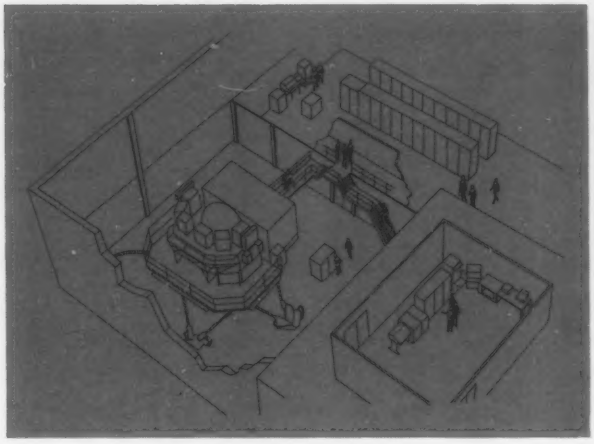
1st Lieutenant Lauren ALLEN
916 AREFS
Travis AFB, CA



Silent, mystic,
The treacherous ice cap challenges,
Provoking us to dare entry, even to dare escape;
Its obscurity, uncertainty, laughs around us
Whistling a torturous, deafening tune.
Yet so calm, peaceful, eternal,
Drowning us in its solitude,
We glide indefinitely to what seems no return,
Our contrails intermingling with the hazy blue
Trapped above the abundant, unending packs of glistening ice
Scarred by an occasional silvery-black silhouette—a crack
Painlessly carved by God.
The silence.
The overwhelming silence.
Is it God we hear?
Do we dare traverse such desolation?
Such serenity?
Such magnitude of mystery and temptation?
We come not for challenge, for we would prove defenseless.
With curious mind and eyes, we merely pass through.
No wish to dominate, we grow confident, proud
A subtle gratitude for the experience, the wonder.
The sun, first bright, now dims in haze as we regress our path,
The brilliance of the stars struggling to endure
The profoundness of the twilight.
Darkness creeps in
Bringing the sensation of the Northern Lights
So unimaginable, so stimulating,
Yet even more powerful, conquering,
They whirl and dance around us, gloriously, gently, quietly.
Off our nose, one victorious star.
Ah, Jupiter!
A peaceful, intriguing aura
We watch entranced,
This turn into the night
So quickly from the day in this awesome land.
So spectacular, so disbelieving.
Then that ball of fire, so precisely round,
So intensely red against the black of space,
Far beneath the horizon, that distant edge of the globe,
Unfettered, it rises,
Slowly approaching its time to reign,
The moon, so small, so seemingly insignificant;
And with its glowing arrival, it greets us,
So magnificent, so breathtaking!
What once was the domain of the day
Is now unequivocally the domain of night.
The sky thickens,
And with the burst of newly-awakened stars,
The perilous ice, haunting us from below,
Fades into the prevailing blackness.
All is at rest.
And in the deep of this arctic fortress
A Tacan lock,
Ah, Alaska at last!



THE C-130E WEAPON SYSTEM TRAINER



Major Michael J. SIEVERDING
34 TATG/TTX
Little Rock AFB, AR

Lieutenant Owens took a seat in the second row of the briefing room along with the rest of his C-130 crew. As a newly assigned tactical airlift navigator, he was noticeably anxious about the mission this brief would outline. Two crews from his squadron were shot down yesterday. He straightened in his seat when Major Roberts, from Tactics, stepped up to the podium.

The major spoke confidently. These briefings were old hat to him, but he knew the pending mission would task Lt Owens and his crew to their limits. "Gentlemen," he began, "the mission is single ship, dropping 34,000 pounds of CDS*, with visual procedures, to an unimproved drop zone (DZ) 80 miles northwest of this base. Your proposed TOA is 1750 local. You will design your own route to and from the DZ and recover back here. DZ run-in must be 355 degrees magnetic." He handed the crew copies of a rough DZ sketch showing the point of impact, tree lines, roads, rivers and buildings.

Major Roberts then continued, "The Combat Control Team (CCT) parachuted in yesterday. They set up two timing panels as marked on your sketch. A radar beacon will mark the point of impact. Smoke cannisters are available to check surface wind and visually confirm the DZ. Civilians were evacuated from the area last week. Still, your drop must be on target due to limited ground personnel and cargo transport equipment. Radio messages from the CCT indicate that only two of the last five airdrops were retrievable. Following your recovery here, expect a 33,000 pound army tank onload for a subsequent LAPES** drop to the same DZ."

Major Roberts then passed out weather flimsies showing good ceiling and visibility but light to moderate turbulence and wind shear at low altitude. He wished the crew good luck and stepped down from the platform.

Captain Teller's intelligence briefing followed. She too was accustomed to briefing combat airdrops. Yet, the information she had for this crew was as difficult for her to brief as it was for them to hear. "Gentlemen," she stated, "RF-4C reconnaissance photos confirm six SA-6 SAM sites along your run-in. There are five 23mm AAA sites north of the DZ." She pointed out the threats on a wall chart and handed a list of coordinates to the crew. Lt Owens studied the list as Captain Teller continued. "Friendly ground forces control the DZ and surrounding valley area. A fire fight with tank activity is occurring four miles north. An SA-7, launched from this general area, downed a C-130 at 1752 local yesterday. To avoid the SAMs you must fly as low as possible during escape. I wish you the best of luck."

Lt Owens and his crew knew that to survive this mission they couldn't rely solely on luck. They had to use every trick in the book to get the cargo on time, on target and live to tell about it. They immediately started designing their route and altitude profile. The plan was to use terrain masking prior to pop-up for the drop. Escape would be risky. If they stayed on the deck after load release and jinked left off the DZ, the SAM radar shouldn't be able to track them through the rugged terrain. Any small arms fire would have to be tolerated until clear. Their C-130 had no ECM.

Just two hours later, the C-130 passed over the initial point for DZ run-in. Lt Owens found all visual checkpoints but one. He made that turn from a radar offset. They were only 30 seconds off flight planned TOA. Prebriefed light to moderate turbulence was more like moderate to moderate. Lt Owen's stomach and the flight engineer's tool bag both floated through the intense jolts. Drop zone line up looked good.

* Container Delivery System.
** Low Altitude Parachute Extraction System.

Pop-up! Slowdown! "Beacon on radar at one o'clock," Lt Owens called. "I've got a visual on the smoke and the PI," answered the co-pilot. Doppler and smoke showed lots of right drift. The pilot adjusted their line up. "Nav has the right timing panel," Lt Owens stated. He hacked his watch.
"Green Light!
Load Clear.
Hit the deck! Escape!"

The C-130 banked hard left. A 23mm AAA site awakened to draw a bead. Flak burst just off their right wing. "Number four engine just died. Clean up checklist! Fire on number four! T-handle...!"

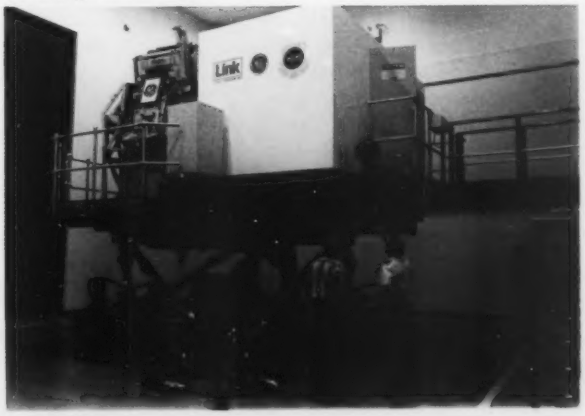
Finally clear of threats, the C-130 climbed. "Number four scans clean," the loadmaster reported. Before the crew could imagine, the base came into view. Following a three-engine approach and white-knuckled touchdown, they had just enough time to check for loose fillings before the next combat airdrop mission.

Does the above scenario sound like fiction? This combat sortie can be flown today in the C-130E Weapon System Trainer (WST) at Little Rock AFB. The tactics used and risks taken in this example were admittedly extreme. Such action would throw peacetime flight safety and combat plans officers into pandemonium. In this mission, however, not a single life was lost and no airframes were damaged, but many valuable combat lessons were learned. After blood pressure stabilizes and sweaty palms dry, the only lingering evidence of the WST experience is improved aircrew skills.

The new C-130E WST is a unique crew trainer in many respects, especially for the navigator. The WST cockpit has virtually the same instruments, seats, noise, and vibration that C-130 fliers have come to know and love. Riding on six large hydraulic legs, the WST provides very realistic motion sensations. It boasts a complete navigator's station with fully functioning equipment, including radar. The radar data base covers 600,000 sq mi of the CONUS and can display hundreds of different weather patterns. WST celestial data includes all HO Volume I stars, the observable planets, the Moon, and the Sun. All of us have plotted celestial LOPs that just don't fall where they should. Often, these "bad" LOPs are not the result of computation or observation errors, but are caused by aircraft acceleration/wander. The WST can train navigators to recognize flight conditions causing wander error and to compensate for it. Celestial training incorporates all observation errors, including autopilot wander, drift change while shooting, and star obscuration by the airframe.

WST weather simulation is taken directly from digitized Air Force Global Weather Central tapes. These tapes provide real-world weather conditions for various millibar pressure levels. The instructor navigator can rotate the weather hemisphere around the poles to select a weather pattern best suited for training. The WST simulates real-world PLOP accuracy, or inaccuracy, and realistically reflects the interactive pressure pattern relationships of true altitude, wind, and temperature.

A computer-generated visual system gives cues for low level flights anywhere within a 33,000 square-mile visual data base. The nearly wingtip-to-wingtip horizontal field of view permits accurate visual navigation and drop zone timing. Visual displays use 256 color hues and 64 levels of color intensity. Data includes more scene features (roads, buildings, and bridges) than found on a JOG chart. These visual and radar data bases were constructed from the same Defense Mapping Agency (DMA) source data and correlate very well. Both data bases can be expanded to any area of the world included in DMA source information. DMA source information is automatically transformed into visual and radar data with minimal hand modeling. Such automation permits mission rehearsal for specific combat locations on relatively short notice. The WST simulates flight in day, dusk, or night, through weather ranging from zero ceiling and visibility to severe clear. Visual presentations include five drop zones, a combat training zone, and three detailed runway complexes with realistic takeoff and landing cues. Hundreds of different instrument approaches can be flown to CONUS and overseas airfields. The WST can fly single ship or with as many as four ships using visual or Station Keeping Equipment (SKE) procedures.



C–130E WST

SEQUENCE OF WST VISUAL IMAGES

Combat training view 2½ miles out from LAPES release point.

Five seconds from LAPES release; note people, vehicles, trees, and timing panels.

Close-up view of farm complex display.

The C-130E WST's instructional features include three onboard instructor stations (pilot, navigator, and flight engineer), more than 1,000 different equipment malfunctions, automatic drop scoring, and freeze capability. The trainer makes consecutive practice of difficult mission segments easy.

In addition to combat airdrop profiles, overwater navigation can be practiced in a WST companion device—the Satellite Navigator Station (SNS). Physically separate from the WST cockpit, the SNS has no motion system, but includes a full navigator station and instructor console. The navigation equipment features the same radar, weather, and celestial capabilities as the WST. The SNS is roughly comparable to Mather's T45 simulator, but with full C-130 navigation avionics and a one-to-one student/instructor ratio. The SNS can be flown on an independent overwater profile while its companion WST flies a tactical airdrop mission. Or, it can be operated as a second navigator station slaved to a WST tactical mission profile.

Completely describing all C-130E WST features would fill a decade's issues of THE NAVIGATOR. WST mission capabilities have application throughout the spectrum of aircrew training and proficiency, from initial qualification to combat training and annual recertification.

Evaluation of the C-130E WST's training value is now underway at Little Rock. Accurate measurement of this quality poses a considerable challenge. The C-130 aircraft was designed as a tactical transport aircraft—the C-130E WST was designed to train. The WST has a high degree of aircraft systems fidelity. It also has many instructional features that the aircraft lacks. Measuring WST training against an aircraft training yardstick might be inappropriate and unsafe. WST training can include scenarios much too dangerous to accomplish in the aircraft. The functional design difference between the aircraft and the WST presents a parallel challenge to those designing the training curriculum. Using the C-130E WST like older-generation trainers won't take full advantage of its unique training utility. The mold that shapes curriculum must be broken and recast to form a complementary generation of training software.

The C-130 navigator has had and will continue to have a fundamental role in the tactical airlift mission. Development of the C-130E WST opens a new chapter in C-130 navigator training and the mission capability of the C-130 airlift force.

By the way, our fictitious Lt Owens scored a drop of 112 yards at 2 o'clock. Respectable, even for CDS.

A 1969 graduate of St Cloud State University, Minnesota, Maj Sieverding was commissioned via OTS. After UNT, he was assigned to Clark AB. Next came assignments to RC-130A photo mapping, the WC-130 at Keesler AFB, and instructor duty at Mather AFB. Maj Sieverding now is a C-130E Simulator Certification Team member.

PROJECT WARRIOR -A HEADQUARTERS PERSPECTIVE

Lieutenant Colonel John F. SHINER
AF/XOXID
The Pentagon

No doubt you've heard of PROJECT WARRIOR, but some of you may still be unsure of what it's all about. Headquarters Air Force launched WARRIOR this past year to resolve two of the Air Force's people-related shortcomings. The first problem is one of attitude and identity. Some Air Force members view their work as an ordinary 8 to 5 job, unrelated to warfighting. Others tend to emphasize management rather than leadership as the proper supervisory approach. The second problem concerns a lack of war-fighting knowledge among Air Force members. Warfare is our profession, yet we have failed to emphasize it. Instead, we've concentrated on such support areas as weapons procurement, resource management, and personnel welfare.

PROJECT WARRIOR's two objectives aim directly at both problems. WARRIOR's first objective—to improve the warfighting spirit and perspective of Air Force people—addresses the attitude and identity issue. We know that a dedicated professional force is essential to national security. Therefore, PROJECT WARRIOR seeks to implant the professional values that distinguished America's warriors of the past—a renewed devotion to "duty, honor, and country." Each of us is an important member of a combat team. As such, we share a unique responsibility. We must be ever prepared to serve, even in the face of great danger. Warfare is at the heart of our profession, and good leadership is essential to combat effectiveness—PROJECT WARRIOR emphasizes these truths.

WARRIOR's second objective, to improve our understanding of the theory and practice of war, aims to resolve the knowledge problem. Special emphasis is placed on the contribution of airpower. We need to know more about war. We must outthink our adversaries if we are going to be successful in warfare. The Soviets possess far more military hardware and manpower than we do. They also are involved in an extensive, ongoing study of combat operations. If we are to deter them, or defeat them in combat, we must know how to do more with less. We also must know how to fight effectively in low-intensity conflicts. Our experience in Vietnam, a decade ago, indicates that technological and numerical superiority do not guarantee victory. As General Lew Allen, Jr. said when initiating PROJECT WARRIOR: "I believe that a continuing study of military history, combat leadership, the principles of war, and particularly the application of airpower, is necessary for us to meet the challenges that lie ahead."

Renewed emphasis on the study of warfare does not mean we want war. However, as guardians of American security, we must be prepared. By meeting both PROJECT WARRIOR objectives, we can create a more dedicated and capable defensive force. This increased dedication will contribute significantly to deterrence. It will also give the United States a more effective Air Force, should deterrence fail.

PROJECT WARRIOR was designed as a long-term process involving all Air Force people—officer, enlisted, civilian, and reserves. It went into full swing on 1 September 1982. Headquarters Air Force continues to develop WARRIOR resources for use in the field. We

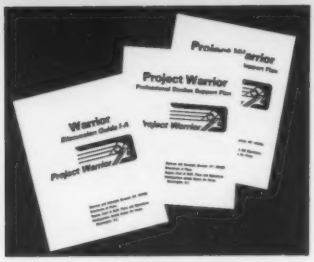
encourage and promote the exchange of ideas between units Air Force-wide, but we want MAJCOMs and local units to design and implement programs that meet their special needs.

To assist you, we've created a professional studies support package containing information on films, books, posters, guest speakers, and war gaming. We're now distributing two discussion guides to assist base and unit-level groups in the study of war. The first guide examines the development and combat experience of our Air Force; the second deals with war fighting in the 1980s. A third discussion guide, presently being prepared by the Air University, will survey the evolution of military thought and warfare over the past 200 years. To support these and other WARRIOR activities, the Air Force Library Service has purchased an extensive collection of books and war-gaming materials for local base libraries.

Still, for PROJECT WARRIOR to achieve its two main objectives, a wide variety of activities at local level is necessary. Three types of activity are most appropriate: (1) those that motivate, (2) those that help people form a personal identification as military professionals, and (3) those that provide Air Force members with a deeper understanding of warfare. Motivational activity can impact on all of us, but it especially affects our newer people. Air Force heritage movies, posters, parades, and motivational speeches all play a part. They help us grasp the importance of what we are doing. Also, they help us realize that we are vital members of a team. Activities that promote professional identification and war skills knowledge include PME courses, military history discussion groups, professional reading programs, war-gaming exercises, and guest speaker programs.

The role of leadership in the WARRIOR effort is an obvious one. Air Force leaders, particularly at squadron and wing levels, can instill a sense of mission and war-fighting spirit in their people and can spark interest in war study. As role models, our leaders are responsible for the professional development of those whom they command.

The continued, active involvement of Air Force leaders, together with unit-level PROJECT WARRIOR activities, can help provide the nation with the combat Air Force it deserves. The ultimate success of WARRIOR depends upon you and your fellow Air Force members. Please lend your support.



PROJECT WARRIOR:
PROFESSIONAL STUDIES OUTLINE

Session	*Title*
1	***PROJECT WARRIOR:*** ***Program Overview***
2	***The American Way of War***
3	***American Military Aviation, 1908-1939***
4	***The Army Air Forces in World War II***
5	***The USAF, Post World War II to Vietnam***
6	***The USAF, Vietnam to Present***
7	***The Spectrum of Modern Warfare***
8	***US Military Forces: The Modern Battlefield***
9	***US Forces: Command, Control, Communications and Intelligence***
10	***US Forces: The Air/Land Battle***
11	***Naval Doctrine and the Rapid Deployment Force***
12	***The Military Professional***

A graduate of the University of Maryland with a master's degree in History, Lt Col Shiner completed pilot training in 1967. After assignment to Lockbourne AFB, in 1971 he served in Vietnam before instructor duty at the USAFA. In 1975, he obtained his PhD in Military History from Ohio State through AFIT. From 1975-82, he served with the USAFA History Dept as professor and department head. Col Shiner now is assigned to the DCS/P&O, Doctrine & Concepts Div, The Pentagon.

AN ARCTIC DILEMMA-THE SOLUTION

Our appreciation to everyone who responded to our Winter '82 issue's celestial quiz—"An Arctic Dilemma." Responses indicated that many of you are keeping your celestial skills sharp. Capt Willie Kasson, who devised the problem, computed a purely mechanical solution:

- Claude Naud's position = 76° 09'N, 100° 04'W
- Sextant Correction = minus 78 (1° 18')
- Heading Home = South, 180°

Capt Rich Van Lommel (see "Put The Stars in Your Pocket," this issue) computed his solution with a TRS-80:

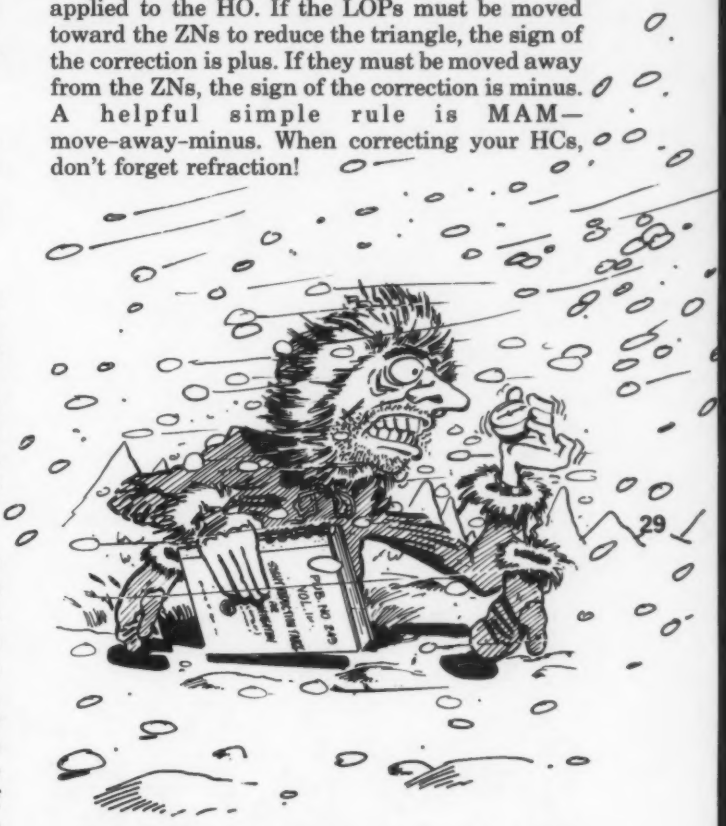
- Claude Naud's position = 76° 11'N, 100° 02'W
- Sextant Correction = minus 75 (1° 15')
- Heading Home = 163° True, 243° Grid

Besides his solution to the problem, Capt Kasson is happy to share other considerations and clues from the narrative that aid in locating poor, lost Claude. First, polar bears only live in the northern hemisphere. This fact eliminates half of the world from consideration and narrows your focus to the polar regions of the northern hemisphere. In his note, the bush pilot did not name the celestial bodies he observed—thus some knowledge of basic celestial theory is helpful.

Since the sun doesn't set above the arctic circle in July, there is little chance that the pilot observed any stars. Capt Kasson admits no knowledge of how to compute GHA or declination of the planets for a date 15 years past. The sun remains as your choice of celestial bodies. Computing a GHA and declination of the sun for a date in July 1968 is the real problem. Directions for computing the sun's GHA and declination, for years from 1965 to 2000, are found in the back of HO volumes II and III. You must also observe that the note with the three HOs is dated 5 July 1968, but the observations were made the day prior. The date for all your calculations should be 4 July 1968.

An assumed position is your choice. You could have used the city of Chibougaumau, in northern Quebec, or you could have selected the true north pole. Choosing the true north pole as your assumed position and converting selected ZNs to grid is helpful but unnecessary to reach a solution. From the initial fix, you gradually rework your computations from the center of each triangle, reducing the intercepts with each step. Eventually, you'll arrive at a fix approximately centered around the magnetic north pole.

To compute the sextant correction, simply measure the average distance from each LOP to the intersection of the bisected angles (the fix). This distance is the amount of the correction to be applied to the HO. If the LOPs must be moved toward the ZNs to reduce the triangle, the sign of the correction is plus. If they must be moved away from the ZNs, the sign of the correction is minus. A helpful simple rule is MAM—move-away-minus. When correcting your HCs, don't forget refraction!



Finally, the easy part. Regardless of Claude Naud's intended destination from the fix, any initial heading from the north magnetic pole will be south—180 degrees.

Congratulations to the two winners in our drawing for pen and pencil sets:

Mr. Eugene O. Frye
Marion, Iowa

Captain Bob Graves
Mather AFB, California

Thanks again to everyone who responded. We appreciate your interest and support.

The B–58 Hustler
(continued from page 15)

early months of 1970, all of the B-58s were in storage at Davis Montham AFB, Arizona—the 'bone yard.' Within a few short years, most of the fleet was cut up for scrap, leaving only six airplanes displayed in museums. These survivors will never fly again, but they still serve as lasting links with one of the most advanced bombers ever built—an airplane of the 1950s whose performance is considered phenomenal—even today.

Capt Woodruff graduated from North Carolina State University in 1972. After completing UNT in 1973, he served in the C-130 at Little Rock AFB until reassigned to Mather AFB in 1978. From 1980-1982, he was Editor of THE NAVIGATOR magazine. Capt Woodruff now is a C-130 navigator instructor.

Nav of Note
(continued from page 2)

Selection as the 93d AREFS Operations Officer was the last step toward fulfilling Col Johnson's dream. He assumed command of the squadron on 14 May 1982.

When questioned about navigator career progression, Colonel Johnson answered, "We must produce, not complain. It is important to work together for success. I recognize that, as a navigator commanding this squadron, or any flying squadron, I will be observed closely by my superiors and those wishing to follow in my footsteps. I thoroughly enjoy the opportunity to positively influence the careers of other navigators."

A charter member and past president of the Navigator Association's Gateway Chapter, Colonel Johnson relates, "I feel this association is very necessary. As navigators, we must be aware of available opportunities and we must learn from the experiences of others. I strongly support and anticipate the formation of a national Navigator Association."

Col Johnson's rules for success are simple and few. First, he has always worked hard. "Work has never bothered me. I volunteered for many jobs that others thought undesirable. Each turned out to be a valuable learning experience and ultimately helped me fulfill a career objective." Second, he has always tried to do more than is expected. "Some navigators have created a self-fulfilling prophecy by believing they have limited opportunity. I always knew I could do more and, with the change in Title 10, doors began to open. I still want to influence more young navigators, perhaps as the training wing commander at Mather."

Finally, Col Johnson has always prepared himself through formal education. He obtained his master's degree in Sociology from Pepperdine University. His PME includes SOS in residence, ACSC by seminar, and National Security Management School (NSM) by correspondence. He presently is Seminar Director/Advisor for the NSM course at Castle, and President of his Air War College seminar.

THE NAVIGATOR AUTHOR'S GUIDE

WHAT TO WRITE: Articles should make a significant contribution to air navigation by conveying information that is unavailable through other channels. THE NAVIGATOR can accommodate a wide range of subjects and styles as long as the information meets that standard. Subjects can include: informative operational experiences; improved procedures, techniques, and equipment; new or proposed navigational methods and equipment; historical articles about people, aircraft, and events; and career or management perspectives.

HOW TO PREPARE AN ARTICLE: Length is optional, but please doublespace your manuscripts. We assume exclusive right of publication so be sure to inform us if you submitted your manuscript to other publications. Avoid excessive use of long sentences, jargon, and acronyms. Write for the navigator in training or the individual aspiring to become a navigator. Provide large black-and-white, glossy photographs, if available, or suggest appropriate illustrations. Your roughly-drawn illustrations will be refined by our production editor. Number pages and identify photos, charts, figures, or illustrations.

HOW TO CLEAR A MANUSCRIPT. Clear your article through your local Air Force Public Affairs Office (PA) and request a security review IAW AFR 190-1. Send a copy of the PA clearance document with your manuscript. (For SAC personnel only: Your security clearance channels are through HQ SAC. Address bomber/bombing related articles to HQ SAC/DOTN and tanker, E-4 and E-3 articles to HQ SAC/DO8T, Offutt AFB, NE 68113.)

SUBMISSION: Include your photograph in Class A uniform, along with a short biography including schools attended, degrees held, and previous assignments. Send to: Editor, THE NAVIGATOR Magazine, 323 FTW/PS, Mather AFB, CA 95655

FOR ASSISTANCE: Write or call us at AUTOVON 828-2138/2089, commercial (916) 364-2138. We are always glad to help with an article at any stage of production, from the basic idea to the polished draft.

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In response to the many phone calls and questions received regarding how to "get on the distribution list for THE NAVIGATOR," the following instructions are provided:

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